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# A multiple buyer – supplier relationship in the context of SMEs' digital supply chain management*

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**ABSTRACT**
By underlining the relevance of the use of ICTs, knowledge sharing and electronic markets for SMEs, it emerges the need for stimulating a debate on digitisation process of supply chain management (SCM). Electronic infrastructure in the service sector are reducing each kind of cost and improving multiply buyer–supplier relationships, facilitating negotiations and transactions. However, since the coordination costs are still high, the use of ICTs is limited. This phenomenon thus attracts the interests of scholars and practitioners. Although it still needs to further investigate. Especially, the optimal use of ICTs within SMEs' SCM have not been studied yet. Therefore, by leveraging on four proxies: ICTs specialised human resources, knowledge sharing activities, buyer–supplier relationships, adoption of electronic markets this optimal was analysed via structural equation modelling based on a sample of 1254 SMEs operating in the service sector in Italy.

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Information and communication technology; digitisation; supply chain management; multiply buyer – supply relationship, SMEs

## 1. Introduction

Townsend et al. in 1998 wrote that 'developments in information and communication technology are on the verge of creating a new revolution in the coming decade' (17). After about 20 years, this revolution is evident and its consequences for the management of social and economic organisations are becoming a relevant topic of investigation (Woolgar 2002; Castells 2011).

Different research streams have investigated the role of information and communication technologies (ICTs) from the organisational structural point of view (Daft and Lengel 1986; Yoo, Henfridsson, and Lyytinen 2010; Daft 2012; Lucas Jr. et al. 2013; Bloom et al. 2014; Vaishnavi and Kuechler 2015), such as from the stakeholders' prospective (Wigand 1997; Rainbird and Munro 2003; Albrecht, Dean, and Hansen 2005; Brodie et al. 2013; Webster and Lusch 2013; Lin and Atkin 2014; Caputo 2016), from the human resources' view (Fulk and DeSanctis 1995; Powell and Dent-Micallef 1997); and from the supply logistic management interpretation (Lambert, Cooper, and Pagh 1998; Lancioni, Smith, and Schau 2003; Holmström and Partanen 2014). It is possible to note that, over the time, the studies on ICTs have acquired an increasing multi- and trans-disciplinary orientation (Klein 2004; Barile, Saviano, and Caputo 2015). A debate has begun on the need to understand how ICTs can support the process of knowledge sharing (Davis and O'Sullivan 1998; Roberts 2000; Cegarra-Navarro, Jiménez, and Martínez-Conesa 2007; Del Giudice, Caputo, and Evangelista 2016) and help the development of buyer–supplier relationships (Hvolby, Trienekens, and Steger-Jensen 2007; Kreng and Chen 2007; Wamba et al. 2015). The ICTs allow companies to reduce their production and transaction costs (Malone, Yates, and Benjamin 1987; Clemons, Reddi, and Row 1993; Gurbaxani and Whang 2001). ICTs also contribute to the development of new relationships as part of the supply chain which generates a value-added partnership. It is then critical to examine the digitisation of supply chain management (SCM).

Companies seek to populate their digital platforms with a variegate number of suppliers using ICTs (Lee and Whang 2002). A multiply supply digital platform represents a space where to sell personalised goods whereas commodities are sold on a single supply digital platform (Dedrick, Xu, and Zhu 2008). Buyer and suppliers, thus, build their relationship using ICTs which have been stimulated recent research: some of them were focusing on how the use of ICTs shapes buyer–supplier relationships (Malone, Yates, and Benjamin 1987; Clemons, Reddi, and Row 1993; Caputo and Walletzky 2017) or how ICTs contribute to the value-added partnership (Bakos and Brynjolfsson 1993; European Commission 2006; Won Lee, Kwon, and Severance 2007) or the link between ICTs and a number of suppliers, offering a distinction between personalised goods and commodities (Dedrick, Xu, and Zhu 2008). However, the optimal balance between coordination costs and a variegate buyer–supplier relationships in the SCM have not been studied yet. With this in mind, the research aims to explore the catalysts of SMEs in the digitisation of the SCM. Empirically,

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four proxies: ICTs specialised human resources, knowledge sharing activities, buyer–supplier relationships, adoption of electronic markets were measured in correlation with the use of ICTs on a sample of 1254 SMEs operating in the service sector in Italy via structural equation modelling (SEM).

The authors deem that a multidisciplinary research stream can offer a better understanding of the impact of ICTs on the SME's SCM (Cooper, Lambert, and Pagh 1997; Simchi-Levi, Simchi-Levi, and Kaminsky 1999; Mentzer et al. 2001; Christopher 2016). The hypotheses thus were built referring to the research stream of buyer–supplier relationships within SCM using ICTs to understand the influence of the above proxies on the use of ICTs within SMEs.

On this basis, the article is structured as follows: the Section 2 argues different theories on the process of digitisation to present the existing studies and shows the gap in the literature which will be bridged by the present study. The Section 3 offers a description of the methodology and demonstrates its suitability. Alongside a detailed picture of the sample is provided. In the Section 4 findings are discussed in line with the existing studies. Finally, in the Section 5 conclusions are offered in addition to implications and future research.

## 2. Study of hypotheses

The research stream focused on the SCM represents a relevant starting point on which to enlarge the traditional perspective about digitisation for SMEs (Chapman and Corso 2005; Fugate, Sahin, and Mentzer 2006; Soosay, Hyland, and Ferrer 2008). As underlined by Cooper and Ellram (1993, 1), the SCM is 'an integrating philosophy to manage the total flow of a distribution channel from supplier to ultimate customer'. The SCM is defined as the integration of key business process from end users through original suppliers who provide products/service and information that add value for customers and other stakeholders (Lambert and Cooper 2000; Hvolby, Trienekens, and Steger-Jensen 2007). The whole process includes different activities, such as information sharing, coordination costs, inventory system among others (Fine 2000; Slack, Lewis, and Bates 2004; Chesbrough, Vanhaverbeke, and West 2006; Pagani 2013; Iansiti and Lakhani 2014; Saviano et al. 2014; Caputo, Del Giudice, et al. 2016,; Caputo, Formisano, et al. 2016). With the spread out of the use of ICTs, external relationships are widely developed (Black, Akintoye, and Fitzgerald 2000; Igartua, Garrigós, and Hervas-Oliver 2010; Berasategi, Arana, and Castellano 2011; Saviano and Caputo 2013; Scuotto, Ferraris, and Bresciani 2016). Indeed to become more open and collaborative, the use of ICTs represents one of the more effective pathways to support actors in sharing information, ideas and knowledge through the supply chain.

SCM provides a shift from an individualistic-competitive to a collective-collaborative view for SMEs' digitisation (Spekman, Kamauff Jr., and Myhr 1998; Horvath 2001; Stank, Keller, and Daugherty 2001). In such a line, Chen and Paulraj (2004) affirm that the SCM offers to SMEs the opportunities to build relational networks based on strategic collaborations acting on the advantages offered by the ICTs. In the same direction, Ketchen and Hult (2007) remark the collective-collaborative approach spurred by a digital SCM within SMEs. These relationships are based on either a single or a multiple transaction (Lambert and Cooper 2000) with either one or more suppliers which operate simultaneously to satisfy customers' needs.

The buyer –supplier relationship is categorised in four typologies: 1. Market exchange; 2. Captive buyer; 3. Strategic partnership; and 4. Captive supplier (Dubois and Pederson 2002) which are also defined as: 1. Standard supplier; 2. Capacity supplier; 3 Key supplier; and 4. System supplier (Hvolby, Trienekens, and Steger-Jensen 2007).

First of all, standard supplier category offers interchangeable products, leveraging the competitive advantage on delivery service, low price and variety of products, etc. Secondly, capacity supplier profile provides personalised products which can be purchased everywhere due to the use of digital platforms.

The third category is the key supplier which offers technical but not customised products. These products are available in just specific platforms. There is a limited number of suppliers and high costs in shifting suppliers. Finally, the last category is the system supplier which is based on highly personalised products, available only in specific platforms. It needs a close collaboration between producers and suppliers to customise the offer and make it available by digital platforms.

In a nutshell, SMEs deal with the high competitive market every day offering personalised products/ services. Such customisation requests for a variegate supplier relationships which avoid the verge of the digitation of SCM such as opportunism risk and scarce fit even if coordination costs could increase (Rispa and Eriksson 2003; Dedrick, Xu, and Zhu 2008). Although the use of ICTs thus is recognised to be as a relevant facilitator in developing and coordinating buyer–supplier relationships (Hvolby and Trienekens 2002). Therefore, we assume that:

> $H_1$: In the context of SMEs' SCM, buyer – supplier relationships are positively correlated to the use of ICTs.

Fundamentally the use of ICTs supports the search of new suppliers and also monitors their performance (Malone, Yates, and Benjamin 1987; Garicano and Kaplan 2001; Scuotto et al. 2017). This due to in part of the friendly use of digital platforms which stimulates knowledge sharing externally and internally (Zhu, Kraemer, and Xu 2006; Scuotto, Del Giudice, and Carayannis 2016). Buyers and suppliers share knowledge through advanced planning system (APS) based on electronic market (Akkermans et al. 2003; Hvolby, Trienekens, and Steger-Jensen 2007). Thanks to the opportunities offered by the use of ICTs, SMEs can better evaluate others actors involved in their supply chain (Van Der Zee and Van Der Vorst 2005) and build strategies and communication approaches direct to ensure the emergence of long term collaborations (Ross 2013). SMEs can also improve their delivery service and offer a wide variegate of products or services (Cainelli, Evangelista, and Savona 2006; Merono-Cerdan, Soto-Acosta, and López-Nicolás 2007). Accordingly, the ICTs can be considered a relevant lever on which acts to ensure a better communication and collaboration among actors involved in the supply chain (Monczka et al. 1998; Zhang, Pieter van Donk, and van der Vaart 2011). In nutshell, ICTs for SCM define intertwined pathways where resources, knowledge, competences, and capabilities are combined to improve both individual and collective SMEs' performances (Akkermans, Bogerd, and Vos 1999; Gunasekaran and Ngai 2004). Therefore since the use of ICTs also enhances the knowledge sharing process (Hendriks 1999; Misuraca and Viscusi 2015; Soto-Acosta, Popa, and Palacios-Marqués 2015; Scuotto, Del Giudice, and Carayannis 2016), as well as SMEs'competitiveness

(Indjikian and Siegel 2005; Kamel, Rateb, and El-Tawil 2009; Michaelides, Morton, and Liu 2013), we stated that:

> $H_2$: In the context of SMEs' SCM, the use of ICTs is positively correlated with knowledge sharing activities.

By contrast it may require more ICTs experts to manage the digital platforms of SCM and these experts are often a limited resource. In fact the conversion from a traditional approach to a digital one within the SCM calls for experienced and skilled human resources which rely mainly on the external environment due to the lack of internal resources of SMEs. The use of ICTs tends to overcome this limit, combining internal and external resources (Akaka, Vargo, and Lusch 2013). Hence, the ICTs offer opportunities to build internal and external collaborations with suppliers (Soosay, Hyland, and Ferrer 2008). In fact Zhang, Pieter van Donk, and van der Vaart (2011) declare that such opportunities stem from the ability of knowledge sharing based mainly on customers' needs. In the same direction, Welker, van der Vaart, and van Donk (2008) outline that ICTs support the digitisation process of a SCM due to virtual nodes which generate multi-level relational network. In this line, the improvement of SMEs' economic performances using ICTs are linked to skills and abilities (Chesbrough and Spohrer 2006; Nurmilaakso 2009; Soto-Acosta, Casado-Lumbreras, and Cabezas-Isla 2010), attitudes and behaviours of human resources (Peña and Villasalero 2010; Pena et al. 2015). Vachon and Klassen (2008) also show that the success of collaborative strategies inside the supply chain is strongly affected by the level of involvement of ICTs human resources which are limited and there are high costs involved.

Hence, since human resources specialised in ICTs are a key driver to support SMEs' organisational setting in the planning and developing of a more competitive supply chain even if are limited and there are high costs involved (Awazu et al. 2009), we declare that:

> $H_3$: In the context of SMEs SCM, the use of ICTs is negatively correlated with the high level of ICTs human resources capabilities.

Alongside, these platforms tend to decrease management costs for new entrants (Bakos and Brynjolfsson 1993) and to offer financial benefits (Frohlich and Westbrook 2002; Wamba et al. 2015). These platforms are recognised as electronic markets where purchase and knowledge sharing take place (Porter 2001). Choudhury, Hartzel, and Konsynski (1998) describes this market as an inter-organisational information system where a variegate number of suppliers and buyers interact and make transactions. Electronic markets are fundamentally set up through ICTs which originate an open network supplier chain aiming to highly integrate the relationship between buyers and suppliers and giving the opportunity to make personalised products/services (Hvolby, Trienekens, and Steger-Jensen 2007; Ding, Chen, and Lyu Jr 2011). Power, Sohal, and Rahman (2001) underline that a digital SCM tends to apply on a collaborative approach which involves simultaneously buyers and suppliers. Therefore, since SMEs thus, seek to establish flexible and agile relationships using electronic markets, we deem that:

> $H_4$: In the context of SMEs' SCM, the use of ICTs within SCM is positively correlated to the adoption of electronic markets.

This open approach generates more opportunities (Barile, Saviano, and Caputo 2014; Cohen and Kietzmann 2014; Barile et al. 2015) even if these opportunities can become relevant risks for enterprises (Bessant et al. 2005). Digitisation is shifting from being an individual process to being collective activities based on collaboration, on information sharing, and on knowledge contamination (Ketchen et al. 2008; Vendrell-Herrero et al. 2017).

## 3. Methodology

### 3.1. Research context

The increasing competitiveness in social and economic dynamics are pushing decision-makers to propose new approaches and strategies (Narula 2004; Borch and Madsen 2007). On this basis, some scholars have pointed out that SMEs need to employ a collaborative approach in order to face the highly competitive markets dominated by multinational companies (Robson and Bennett 2000; Welbourne and Pardo-del-Val 2009). Strategies thus have been suggested in the field of relational and internal marketing (Grönroos 1990; Joseph 1996) and networking (Provan and Sebastian 1998). Alongside with the spread-out of the digital revolution, studies on the role of ICTs in making collaborations between enterprises were provided (Barba-Sánchez, del Pilar Martínez-Ruiz, and Jiménez-Zarco 2007; Lopez-Nicolas and Soto-Acosta 2010) but just few scholars have analysed the evolution of collaborations between enterprises and suppliers in the digital era (Devaraj, Krajewski, and Wei 2007; Vaaland and Heide 2007; Welker, van der Vaart, and van Donk 2008; Di Nauta et al. 2015; Vendrell-Herrero et al. 2017). For instance, Yee-Loong Chong et al. (2009) show that the ICTs are offering the new building block on which SMEs can act to improve the quality of collaboration inside their supply chain.

In such scenario emerges that mainly SMEs in the service sector are adopting electronic markets to develop a buyer–supplier relationship using ICTs. Accordingly, Benjamin and Wigand (1995) state that the electronic infrastructures in the service sector are reducing distribution costs. Lancastre and Lages (2006) emphasise the multiple positive effects that electronic markets and the use of ICTs have on the buyer–supplier relationships in terms of enhancing communication networks, increasing level of trust and improving coordination costs.

With this in mind, the research explores the use of ICTs in the process of SCM digitisation within SMEs operating in the service sector in Italy. This research context is considered a suitable for this study due to the increasing attention paid to the use of ICTs within the SMEs (Accenture & G20 Young Entrepreneurs Alliance 2015; Assiform 2015). Accordingly, the Italian Institute for Statistic (ISTAT 2016) shows that the 25% of Italian SMEs have employed human resources specialised in the use of ICTs due to an increase of 65% of the use of cloud computing services in the last five years. In addition to the % of SMEs which uses social media platforms to communicate with a broad number of worldwide stakeholders and the 75% of SMEs that uses ICTs to share information with others companies.

### 3.2. Sample

By a data-set provided by the Italian National Institute for Statistics (ISTAT 2016), we selected our sample. Therefore, on a population of 187,678 enterprises form a diverse set of industries and business forms, 7685 companies were identified as SMEs using the following criteria: 1.staff headcount; 2. either

Table 1. Variables, items and essential references.

| Variables | Items | References |
|---|---|---|
| Buyer–supplier relationships | Coordination costs<br>Transition costs | Heide and John (1990), Han (1993), Brennan and Turnbull (1999), Carr and Pearson (1999), Cannon and Homburg (2001), Paulraj, Lado, and Chen (2008) |
| Knowledge sharing activities | Open networks<br>Collaborative approach | Kotabe, Martin, and Domoto (2003), Corsten and Felde (2005), Wuyts and Geyskens (2005), Hsu et al. (2008), Squire, Cousins, and Brown (2009) |
| ICT specialised human resources | IT capabilities<br>Combination of internal and external human resources | Claro, Zylbersztajn, and Omta (2004), Wynstra, Axelsson, and van der Valk (2006), Pitelis (2009), Wamba et al. (2015) |
| Electronic Markets | Use of Compatible technologies<br>Multiply suppliers | Heide and John (1990), Bakos and Brynjolfsson (1993), Benjamin and Wigand (1995), Roberts and Mackay (1998) |
| Use of ICTs | Embracing digital technologies in the SCM | Lambert and Cooper (2000), Sambamurthy, Bharadwaj, and Grover (2003), De Burca, Fynes, and Marshall (2005) |

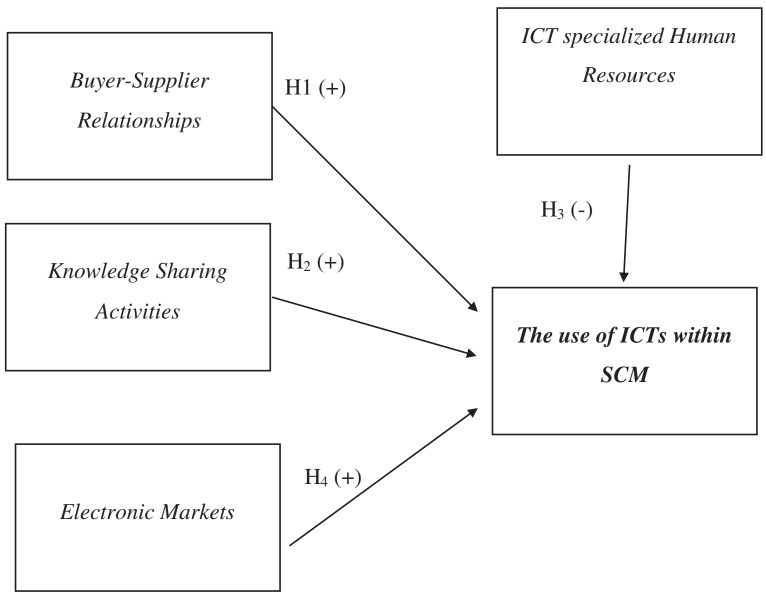


Figure 1. Conceptual model.

turnover or balance sheet total (Bortolotti and Romano 2012); and 3. Operating in the service sector.

A further screening was made, selecting whose could be framed in the category of supplier system as follows:

(1) Offering highly personalised products;
(2) Use of compatible technologies between suppliers and buyers;
(3) Use of electronic markets (Hvolby, Trienekens, and Steger-Jensen 2007).

From which emerged that just 1254 SMEs were categorised as supplier system but only 682 completed the questionnaire.

### 3.3. Research design

In line with the afore-mentioned literature and hypotheses, four proxies (or latent variables) are individuated: buyer–supplier relationships, knowledge sharing activities, ICT specialised human resources, adoption of electronic markets and associated with items (Table 1).

Moreover as showed in the Figure 1, each proxy is and measured in relation to the use of ICTs via structural equation modelling.

## 4. Findings

The reliability of these data are measured via Cronbach's alpha which is the most commonly accepted measure of internal consistency and reliability for scores produced by a research instrument (Hinkin 1995). Consequently, a construct validity test is conducted (AVE and common bias analysis). Finally, the hypotheses are tested via SEM. The relationship of each proxy with the dependent variable 'use of ICTs' is accurately evaluated by a path analysis (MacCallum and Austin 2000).

### 4.1. Internal consistency, reliability, and construct validity

To estimate the internal consistency and reliability the Cronbach's alpha (α) test was applied. The Cronbach's alpha value of 0.70 or greater is recognised as being a suitable mean for applied research (Nunnally 1978). As showed in Table 2, all Cronbach's alpha coefficients exceed the cut-off value of 0.7. Construct validity was analysed by referring to convergent validity and discriminant validity. Convergent validity was measured by calculating the average variance extracted (AVE), and discriminant validity was tested by comparing the square roots of the AVEs with the correlations between the constructs. Results showed that the square roots of the AVEs were all greater than

Table 2. Internal consistency reliability and correlations between study constructs.

| | | Cronbach's Alpha | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|---|---|
| (1) | BUY-SUPrelat | 0.81 | 1 | | | | | | |
| (2) | KNOWSHARE | 0.73 | 0.732** | 1 | | | | | |
| (3) | ICTsHR | 0.82 | 0.478** | 0.786** | 1 | | | | |
| (4) | ELECMARK | 0.81 | 0.512** | 0.584** | 0.764** | 1 | | | |
| (5) | USEICTs | 0.84 | 0.596** | 0.721** | 0.643** | 0.745** | 1 | | |

Notes: **Correlation is significant at the 0.01 level (two-tailed).

Table 3. Coefficients.

| | Unstandardised coefficients | | Stansdardised coefficients[a] | $T$ | $P$-Value |
|---|---|---|---|---|---|
| Model | $B$ | Std. error | $\beta$ | | |
| $H_1$(+): BUY-SUPrelat→ USEICTs | 0.537 | 0.054 | 0.110 | 2.5 | 0.631 |
| $H_2$(+): KNOWSHARE→USEICTs | 0.622 | 0.001 | 0.151 | 5.4 | 0.001 |
| $H_3$(−): ICTsHR→USEICTs 0 | 0.679 | 0.007 | 0.437 | 0.4 | 0 |
| $H_4$(+): ELECMARK→USEICTs | 0.504 | 0.005 | 0.401 | 6.7 | 0.001 |

Notes: *Model fit statistics:* $\chi^2 = 25.385$, df = 21, $\chi^2$/df = 1.209, GFI = 0.990, AGFI = 0.983, PGFI = 0.0, RMSEA = 0.000, SRMR = 0.0279.

their respective relationships, providing solid evidences of discriminant validity (Table 2).

### 4.2. Hypothesis testing via SEM

The hypotheses are tested via SEM as shown in Table 3. A number of model fit statistics, including $\chi^2$, df, $\chi^2$/df, GFI, AGFI, PGFI and RMSEA, are reported. The following cut-off values were applied: <=3 for $i^2$/df (Byrne 2001), >0.90 for GFI (Jöreskog and Sörbom 1996; Hoe 2008), >0.90 for AGFI (Li et al. 2007), >0.50 for PGFI (Mulaik et al. 1989), and a combinatorial rule of RMSEA < 0.06 and SRMR < 0.08 (Hooper, Coughlan, and Mullen 2008). As it emerged, the entire the model fit exceeded the conventional thresholds ($\chi^2 = 25.385$, df = 21, $\chi^2$/df = 1.209, GFI = 0.990, AGFI = 0.983, PGFI = 0.0, RMSEA = 0.000, SRMR = 0.0279), indicating a good model fit to the data.

Table 3 also reports the standardised regression coefficients and corresponding $p$-values. Considering $H_1$: There is a positive relationship between the use of ICTs and buyer–supplier relationships ($\beta = 0.537$, $p = 0.631$). $H_1$ is therefore supported. $H_2$ is supported, as knowledge sharing activities are significantly and positively associated with the use of ICTs ($\beta = 0.622$, $p < 0.001$). Regarding $H_3$, it is not supported because ICT specialised human resources is not negatively related to the use of ICTs ($\beta = 0.679$, $p = 0.234$). $H_4$ is supported, as the relationship between electronic markets and the use of ICTs is positively related ($\beta = 0.504$, $p = 0.210$). Collectively, the SEM results are summarised in Figure 2.

## 5. Discussion, implications, final remarks and future lines of research

From the empirical research all four proxies: buyer–supplier relationships, knowledge sharing activities, ICT specialised human resources, adoption of electronic markets are resulted to be relevant to the use of ICTs in the context of SMEs' SCM. The findings contribute to enhance the theoretical perspectives on the digitisation of SCM (Hvolby, Trienekens, and Steger-Jensen 2007; Dedrick, Xu, and Zhu 2008; Xue et al. 2013; Vendrell-Herrero et al. 2017).

An interesting outcome emerges from the non–significant $H_3$ which stated that in the context of the SCM, the use of ICTs is negatively correlated with the high level of ICTs human resources capabilities ($H_3$). Accordingly, the results show that there is not a negative correlation rejecting Matlay and Westhead's opinion (2007) which state that internal and external collaborations in SMEs are directly related to SMEs' ability to adopt and use innovative processes and new technologies but not to the existence of advanced knowledge about ICTs processes and structures.

By contrast Bramwell, Nelles, and Wolfe (2008) declare that SMEs operating in digital markets need high skilled ICTs human resources to survive in the current economy. Ahmed (2006) asserts that the interaction among human resources is the key driver on which acts to promote the digital transformation of companies' organisations, processes, and activities. Mutula and Van Brakel (2007) also demonstrate the important role of ICTs human resources conducting a qualitative research on a small number of stakeholders in the ICT sector. In a nutshell, ICTs human resources emerge to be a relevant key driver for a competitive advantage and it thus needs to further investigate.

Despite that, the other hypotheses are confirmed. The relationship between buyerand supplier relationships and the use of ICTs is positive ($H_1$) which is in line with some previous studies (Addison and Heshmati 2003; Dedrick, Xu, and Zhu 2008; Xue et al. 2013; Vendrell-Herrero et al. 2017). Although SMEs deal with the complex world of the digital system when they interact with their supplier, the allocation of ICTs within their SCM is a key factor because it generates a value-added partnership and value generation (Bakos and Brynjolfsson 1993; Won Lee, Kwon, and Severance 2007). ICTs offer an accessible venue to both parties where to interact and negotiate the best deal (Bustinza et al. 2013). Offering a multiply supplier platform allows SMEs to have more power on consumers' choices (Lepak, Smith, and Taylor 2007; Yoo and Lee 2011; Porter and Heppelmann 2014) and also have a better control on B2B relations (Wise and Baumgartner 1999). Moreover the use of ICTs supports the development of knowledge sharing activities (Hafkesbrink and Schroll 2011).

In the knowledge economy, knowledge and information sharing both within firms (Villasalero 2013, 2014a, 2017) and across

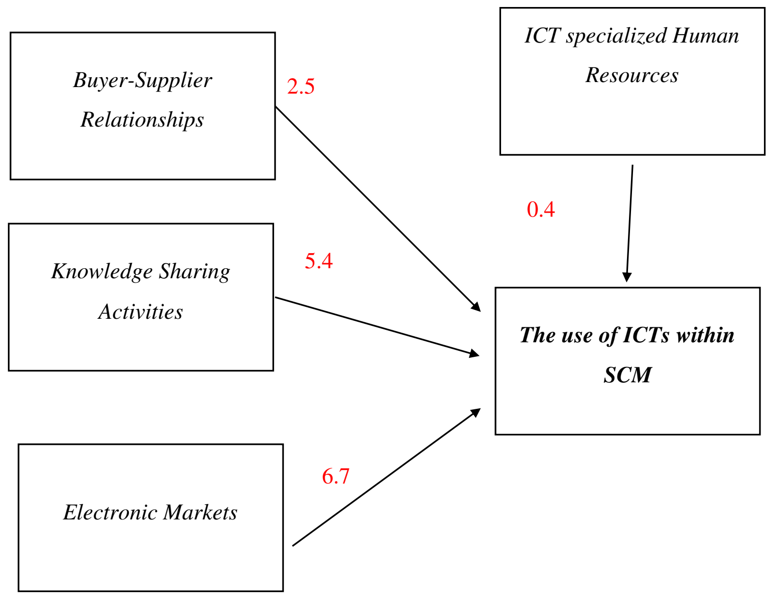


**Figure 2.** SEM results.

firm boundaries (Villasalero 2015, 2014b; D'Ambrosio et al. 2017) have become key to competitiveness, learning and innovation. Accordingly, the results also confirmed that there is a positive relationship between the use of ICTs and knowledge sharing activities ($H_2$). Emmerik and Sanders (2004) asserts that the embeddedness of ICTs encourages SMEs to be more open – minded and sharing the core information to develop strong buyer–supply relationship. With this in mind, other scholars supported the idea that the knowledge sharing activities with other economic and social actors exerts an impact on their economic performance (Indjikian and Siegel 2005; Vaccaro, Parente, and Veloso 2010). Lin (2007) demonstrates that the digital knowledge sharing can influence companies' structure affecting decision makers' chooses and willingness in the adoption of new technologies. While Ardichvili, Page, and Wentling (2003) underline the relevant role of knowledge sharing in supporting the emergence of the internal digitalisation process for enterprises, conducting a qualitative study on motivations and barriers of employees' engagement in virtual knowledge-sharing communities. These knowledge sharing activities take place on the new digital venue known as electronic market (Porter 2001) which reflects the final result. In fact in conclusion the relationship between the use of ICTs and the adoption of electronic markets is significant ($H_4$). This results rejects the statement that ICTs affect SMEs' economic performances but they are not able to ensure the competitive of companies in the virtual environment (Martin and Matlay 2001). In fact, the digitisation encourages new entrants and provides financial benefits (Bakos and Brynjolfsson 1993; Frohlich and Westbrook 2002; Wamba et al. 2015). SMEs are operating in an inter-organisational information system where they interact and negotiate with a variegate number of suppliers (Choudhury, Hartzel, and Konsynski 1998; Ding, Chen, and Lyu Jr 2011). Power, Sohal, and Rahman (2001) underline that SCM tend to be based on a collaborative approach which involves simultaneously buyers and suppliers. Electronic markets are fundamentally set up through ICTs which originate open network supplier chain aiming to highly integrate the relationship between buyers and suppliers and giving the opportunity to make personalised products/services (Hvolby, Trienekens, and Steger-Jensen 2007).

From a more general viewpoint, it is possible to affirm that the impact of ICT tools on SMEs' digitalisation economic performance also depends by contextual elements, such as the sector of activities, the sensibility of other social and economic actors to the use of ICTs, the presence of infrastructure adapted to the use of ICT tools (Neely et al. 2001).

Briefly, it is possible to affirm that ICTs are acquiring increasing relevance onto enterprises' activities (Barba-Sánchez, del Pilar Martínez-Ruiz, and Jiménez-Zarco 2007). ICT tools cannot be considered only a possible instrument for enterprises; they are becoming an obligatory pathway for firms that aim to act in the market as proponents and not only as victims of social and economic trends (Palacios-Marqués, Merigó, and Soto-Acosta 2015; Palacios-Marqués, Soto-Acosta, and Merigó 2015).

From a practical point of view, SMEs' decision-makers need to invest more in ICTs as well as in ICT skilled human resources which may help the overcoming of the verge of the digitation of SCM such as opportunism risk and scarce fit. However, the present study investigated just the system supplier category which needs for a multi-variegate fit of customised products, a further research thus should analyse the other categories. Alongside a comparative analysis could be made to understand the different behaviour of those categories. Another limit is the research context because only one research context is explored. Hence, more countries could be involved in order to offer a broad view of the phenomenon. Moreover, this research can be improved analysing the reasons for example, of the insignificant relationship between intensive involvement of human resources in organisational planning and SMEs' digitalisation. A qualitative approach might be applied to this empirical analysis to investigate in depth the way in which the digitalisation supports the implementation of really open and collaborative frameworks inside and outside firms. Finally, showing the relevant relationships of four proxies with the use of ICTs, we believe that the use of ICTs could improve SMEs' innovativeness as stated by (Llamas and Belk 2013): SMEs become more digital as a 'vulcan forging wondrous new things from digital magma' (10). This aspect could enhance another further research.

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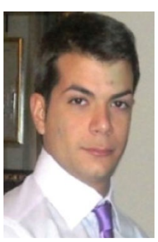

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